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The Medium of Presentation in Assessment of Riparian Scenic Quality

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A prevalent though unstated assumption throughout much of the empirical research in environmental preference is that the more closely experimental conditions represent real-life experiences, the more the results will reflect actual responses to the studied environment[1]. In other words, a direct relationship exists between the representativeness of the design toward real-life experience and the accuracy, applicability, and utility of the subsequent results. Consequently, environmental preference researchers, knowing that experimental conditions are not the same as real-life experiences, have periodically concentrated on issues concerning the validity and reliability of their methods (Daniel & Boster, 1976; Shuttleworth, 1980; Feimer, 1984; Brown & Daniel, 1987).

Evaluating validity in environmental preference research, however, is a complex process, which requires careful investigation of the many experimental elements that influence environmental assessments. A number of authors (Craik, 1971; Bosselmann & Craik, 1987; Craik & Feimer, 1987) have organized these design elements into five general factors: (1) the characteristics of the observers, (2) the medium selected for presentation, (3) the response format, (4) the relevant

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[1]We refer to this as an assumption, rather than fact, simply because the statement can never be tested. Although many experiments concerning the validity of landscape preference methods compare experimental conditions to in situ conditions, we recognize that even on-site assessments rely on a particular presentation of the environment, response measure, and experimental context that may differ from actual experience of the landscape.

environmental attributes of the settings, and (5) the nature of the experimental transaction. Although each factor is equally important, the emphasis of this study will concern issues of validity regarding the medium of presentation.

Assessing the validity of the presentation medium in environmental assessment generally concerns the adequacy, or sufficiency, of the medium to represent important elements of the environment for whatever task the subject is asked to perform. An issue pertinent to evaluating the adequacy of a presentation medium, though rarely investigated in environment perception research, is incremental validity (Sechrest, 1963), or "to what extent adding an extra sensory channel to the simulator would increase the amount of information communicated and enhance the predictive validity of the technique" (McKechnie, 1977, p.172). The strategy behind assessing incremental validity begins with the minimum necessary and sufficient elements that need to be preserved in an environmental representation to ensure its validity, and then considers whether or not added environmental information would enhance a representation's ability to better predict responses to the actual environment.

Assessment of the incremental validity of visual representations allows the researcher to evaluate the appropriateness of the selected medium (i.e., does the medium minimally preserve the necessary and sufficient elements of a landscape to evoke the desired response). In this regard, prominent researchers (Wohlwill, 1976; Ittelson, 1973) have

acknowledged that perception of the environment is, in principle, multi-modal, while environment preference research has consistently relied on uni-modal (viz., visual) representations (Gifford & Fan Ng, 1982). Despite this lack of environmental information, a number of researchers (e.g., Daniel & Boster, 1976; Shuttleworth, 1980; Zube et al., 1975) have compared color slide and photograph media to on-site assessments of perceived scenic beauty, and have reported high correlations accounting for most of the systematic variation.

The utility of the previous validity research, however, is limited to a relatively motionless environment, because the represented landscapes did not contain any prominently dynamic elements (e.g., a flowing river or waterfall). Previous research has demonstrated that static representations, such as slides and photographs, sufficiently preserve the relevant characteristics of relatively motionless landscapes for assessments of perceived scenic beauty. Static representations of landscapes with dynamic elements, however, have yet to be exhaustively investigated.

Dynamic Environment vs. Dynamic Representation

A distinction not commonly made in environment preference research is between the movement of an observer through an environment and the movement of the environment per se. The first category refers to simulated movement and is normally imitated by moving a video camera through an environment (i.e., a dynamic representation of a relatively static environment). The second category refers to the preservation of a dynamic element

by the representation medium (i.e., a dynamic representation of a dynamic environment).

Motion pictures and video have been used to represent dynamic movement of the observer through static models of environments since the early 1970s (Craik & Feimer, 1987; Zube, Simcox & Law, 1987). However, empirical research involving dynamic representations of natural environments is quite limited. Banerjee (1977) used color 16mm film to examine the scenic beauty of several costal areas, Feimer (1984) used 16mm color film to represent a nine-mile automobile tour through Marin County, California, and Ulrich and Simmons (1986) used video to represent various urban environments to investigate psychophysiological recovery from stressors. Vining and Orland (1989) compared static and dynamic representations of a residential landscape, and found considerable agreement between the two different representational media. However, the landscape represented in all of these examples was relatively motionless, and therefore could not be used to investigate the independent effect of a dynamic representation.

One study, Brown and Daniel (1991), employed a dynamic representational medium to represent a Wild and Scenic river (the Cache-La Poudre in Colorado) in order to investigate the effects of in-stream flow rates on visual preferences. Differences in flow rate, specifically a polynomial function, accounted for a significant proportion of the variation in estimates of perceived scenic beauty in the video representation. However, only results

from a dynamic medium were reported, so the incremental effect of the addition of motion in the representation could not be assessed in relation to a static medium.

A controlled evaluation of the presence of motion in visual representations must satisfy at least two criteria: (1) a landscape with a significant dynamic element must be the subject of the representation, and (2) the presentation of motion must be varied across different medium conditions. Without motion in the studied landscape, the incremental benefit of preserving motion in the representational medium cannot be assessed. Furthermore, both dynamic and static representations of the same landscape need to be compared.

Sound

Environmental perception research has focused almost exclusively on the visual attributes of an environment (Gifford & Fan Ng, 1982), even though some researchers have acknowledged that "Many sounds and smells in natural settings surely also influence our feelings" (Ulrich, 1983, p.86). Quality research has been conducted regarding the sonic characteristics of an environment (Porteous, 1982; Porteous & Mastin, 1987). Such studies investigate the "soundscape" or entire continuum of sound in an environment, and do not limit the investigation to a single aural element (e.g., noise). However, such research focuses exclusively on sonic qualities and does not present visual information in tandem. Therefore, the applicability and utility of this research is subject to the same criticisms previously

outlined against the exclusive use of visual representations in preference research.

Nevertheless, landscape preference research has occasionally included auditory stimulation (e.g., Brown & Daniel, 1991), but the inclusion of the extra modality is generally not varied across conditions. In other words, sound is always presented in conjunction with the visual presentation, and therefore cannot be independently assessed. In the few instances that visual and auditory modalities have been investigated together (e.g., Gifford & Fan Ng, 1982), the represented environment was urban--not natural. Hence, any extrapolation of the results to preferences in natural landscapes from such research would be speculative.

One study, Anderson et al. (1983), added sound to static representations of <u>both</u> urban and natural environments. When the sound of chirping birds was added to slides of a natural environment, preference ratings increased. When the sound of traffic was added to slide of urban environments, preference ratings decreased. When the sound was not directly associated with an element within the representation (e.g., hearing the chirping of birds without seeing the birds or hearing car horns without seeing cars), the result was inconsistency in the subjects' preference ratings. The authors concluded that although appropriate sounds for either natural or urban environments had predictable results, inappropriate sounds led to confusion on the part of the observer as to the meaning of the

information presented.

A controlled evaluation of the presence of sound in visual representations must vary the presentation of sound across different conditions in order to provide an estimate of the effect of auditory information in the presentation medium. However, the sounds accompanying the visual representation must allow for a meaningful interpretation of the environment. To incrementally investigate the influence of sound, in other terms, the presence of sound needs to be varied for the same representational medium and the accompanying sounds should not conflict with the visual information provided.

Method

The specific focus of the following research was to investigate the incremental benefits of the addition of motion and sound to a representation of a dynamic environment. A psychophysical approach was adapted to assess the effects of different representational media on observers' ratings of scenic beauty. In the first experiment the presence of motion in the media of presentation was varied across two different representational media of the same landscape. In the second experiment the presence of both motion and sound were varied across different representations of the same landscape.

Experiment 1

The purpose of the first experiment was to compare static and dynamic representations of a landscape with a significant dynamic element. The study landscape, the Cache-La Poudre river,

was selected because of previously identified physical variables (viz., in-stream flow levels), known scenic beauty values, and accessibility of stimuli.

Stimuli

In Brown and Daniel (1991), thirty-two points were selected along a 40-mile designated wild and scenic stretch of the Cache-La Poudre River. Three criteria were used to determine the photo points: (1) variety of view distance (e.g., near-view and vista), (2) representativeness of typical visitation patterns, and (3) absence of man-made structures. Photo points were marked to ensure that the exact same view was captured each time the photographer returned to the site. Since video footage and color slides were repetitively taken at the same photo point, we will refer to "view" as the landscape area being repetitively photographed and "scene" as a view at a specific flow level.

Each photo point yielded two views, as video recordings and color slides were taken looking both upstream and downstream from the point, for a total of up to 64 views. For the video sequences, a representative range (from 2643 cfs to 152 cfs) of 8 flow levels were recorded from June 7 to September 9, 1988. Video sequences were taken for 30 seconds on 3/4" video film with a Sony DXC-1610 camera and Sony VO-3800 sound recorder. The 30 second video segments were later edited to 12 seconds to eliminate unwanted intrusions (e.g., automobiles) and poor photographic quality for presentation to observers. After further elimination of poor quality video sequences, 220 scenes

remained representing 22 photo points at up to 8 flow levels.

For the color slides, a representative range (from 3092 cfs to 34 cfs) of 13 flow levels were taken from June 9 to October 17, 1988. The color slides were captured with a 35mm camera with a 50mm lens using Kodachrome (ASA 64) film. After eliminating poor quality and fall color slides, 522 scenes remained representing thirty-two points at up to 12 flow levels. Ideally, the slide and video scenes would have been taken on the same days. However, only one photographer was available on a given day, and there was not sufficient time in a day to use both media.

Flow volume was estimated for each scene in each condition at a U.S. Geological Survey (USGS) gauge downstream of the inventory points. Flow estimates were adjusted for diversions, inflows from tributaries, and transbasin diversions to arrive at the nominal flow levels listed in Table 1.

Design

To investigate the effects of preserving the existing motion of a dynamic landscape, scenic beauty judgments needed to be obtained in both dynamic and static media conditions. The results of the dynamic video condition were previously reported in Brown and Daniel (1991) and the results of the static color slide condition were previously reported in Brown and Daniel (1989).

Video Condition. For the video sequences, twenty of the 220 scenes were randomly selected for the baseline, and the remaining

scenes were randomly sorted into three sets of 66 to 67 unique sequences (See Table 2). Any given set of scenes rarely included more than three scenes (i.e., flow levels) of the same view. The twenty baseline scenes were added to the unique subsets, and three random orders were created for each set. However, baseline scenes were placed in every 4th position, beginning with the 4th position to ensure that different scenes of the same view were spread out among scenes from other views.

Presentation of the three random orders for each of the three sets required a total of nine observer groups. Each group viewed a separate specially prepared videotapes. The video sequences were displayed on a 25" Sony Trinitron Color Video Monitor (PVM-2530), using a commercial high quality four-head videotape player.

Color Slide Condition. For the color slides, nineteen of the 522 scenes were randomly selected for the baseline, and the remaining scenes were randomly sorted into four sets of 111 to 132 unique slides (See Table 2). Any given set of scenes rarely included more than three scenes (i.e., flow levels) of the same view. The nineteen baseline scenes were added to the unique subsets, and four random orders were created for each set. However, baseline scenes were placed in every 5th position, beginning with the 5th position to ensure that different scenes of the same view were spread out among scenes from other views.

Presentation of the four random orders for each of the three sets required a total of twelve observer groups. Each group

viewed a separate specially prepared slide presentation. The color slides were displayed using a Kodak slide projector (650H).

Procedure. The procedure for both conditions was the same. After being read the instructions by the experimenter, subjects viewed twenty preview scenes, randomly selected within each condition, that depicted the full range of flow level and types of scenes later to be rated. Preview scenes were shown for approximately 5 seconds each.

Observers were then instructed to rate the scenic beauty of each scene on a 10-point scale, where a rating of 1 indicated low scenic beauty and 10 indicated high scenic beauty. Subjects were also asked to use the full range of the 10-point scale in order to compare the scenic quality of one area to another. The scenes for the video condition were shown for 12 seconds each, while the scenes in the slide condition were shown for 8 seconds each.

For both conditions, subjects' ratings for each randomized order were adjusted for presentation order, and then scaled using the program RMRATE (Brown et al., 1990) to produce Scenic Beauty Estimates (SBEs) for each scene. This scaling procedure translates raw ratings into a standardized interval scale index in order to control for variations in an individual's use of the arbitrary 10-point scenic beauty rating scale. The origin of the SBE scale is defined by the baseline scenes common to each of the random orders.

Subjects. Observers were nested within each condition, scene set, and random order, such that no one subject rated more

than one random order, scene set, or condition. Observers were enrolled in introductory psychology classes at the University of Arizona, and each student received partial credit toward a research requirement for participation.

For the video condition, group size ranged in size from 7 to 13 observers, and a total of 85 students rated the video scenes. For the slide condition, group size ranged from 7 to 22 observers, and a total of 149 students rated the color slides. A complete listing of subject participation is provided in Table 2. In all, 234 subjects rated the river scenes.

Results

Random Orders. Baseline scenes were common to all random orders and scenes sets within each condition, so the correlations between the baseline values of different random orders provides an indication of the level of agreement between random orders. For the 3 sets of random orders in the video condition, the 9 pairwise correlations ranged from 0.47 to 0.82, with a median of .63 (Table 3). For the 4 sets of random orders in the slide condition, the 12 pairwise correlations ranged from 0.09 to 0.86, with a median of 0.71 (Table 3). Although generally lower than baseline correlations for forest scenes (Brown & Daniel, 1987), the different random orders nested within each set were combined.

Combining across observer groups who viewed the same set of scenes in different random orders, the baseline correlations were higher and more comparable to those of previous scenic beauty studies. Among the four slide sets, the 6 baseline correlations

ranged from 0.57 to 0.84, with a median of 0.73. For the three video scene sets, the three correlations were 0.85, 0.86, and 0.87 (Table 4).

Reliabilities. The group-to-group correlation, an indicator of the mean correlation between the experimental sample and any other hypothetical sample of the same size drawn from the same population, was used as a measure of the reliability of the ratings within condition (Ebel, 1951). The group-to-group reliability coefficient ranged from 0.81 to 0.89 for the 3 video condition photo sets and from 0.69 to 0.83 for the 4 slide condition photo sets (Table 5). These reliabilities indicate substantial agreement among observer groups about the relative scenic beauty of the scenes, and also greater agreement when the scenes are depicted on video than on slides. However, these reliabilities are slightly lower than those obtained for prior scenic beauty ratings of forest scenes (Brown & Daniel, 1987).

Relationship of Flow and Scenic Beauty. The relationship between flow level and scenic beauty was assessed by regressing the SBE values on the flow level measures across all scenes within each condition. Since prior research indicated the possible existence of a polynomial function (Brown & Daniel, 1991), flow level was entered into the regression equation as both a simple and squared term. The resulting regression equations for both the slide and video conditions are presented in Table 6.

The data in the slide condition do not indicate a

significant relationship between SBE and flow level, because the simple and polynomial flow terms did not explain a significant proportion of variance in SBE values whether taken individually or collectively. The data in the video condition, however, did indicate a significant relationship between SBE and flow level for both the simple and polynomial flow terms. The dynamic representation of the river was able to incrementally capture variance in scenic beauty judgments lost in the slide condition.

The SBE values for each flow level were averaged across all of the unique scenes within each condition, and the resulting averages were plotted for both conditions in Figure 1. Whereas the slide condition shows neither a linear nor polynomial function, the video condition clearly represents a concave or inverted U-shaped relationship, such that scenic beauty initially increases with flow level and then decreases as flow continues to increase. Apparently flow, a dynamic element of the river landscape, could not be sufficiently represented in the slide condition.

Although Experiment 1 clearly illustrated differences in scenic beauty judgments across static and dynamic representations, numerous technical problems existed in the initial design which limited the utility of the results. Since the images for the slide and video conditions could not be taken on the same day, differences in lighting and weather conditions manifested between the different representational media. Furthermore, framing, lens angle and photographic quality factors

could not be precisely matched because of the different equipment and procedures used to capture the images.

Experiment 2

The purpose of the second experiment was to compare the presence of both motion and sound in representations of a landscape with a significant dynamic element under more controlled conditions than Experiment 1. Three representational conditions[2] were identified under which to investigate the effects of sound and motion: (1) video with sound (VS), (2) video without sound (VNS), and (3) static images without sound (DI).

Stimuli

For the video conditions, the same video sequences previously described in Experiment 1 were used. New video sequences were not necessary as the presence of sound was varied at the monitor. For the static condition, the problems formerly identified with comparing different representational media needed to be addressed (e.g., weather, framing, composition, color quality, and resolution). To eliminate this unwanted variation, digitized images were captured from each video scene using a TARGA 16 Video image board and TIPS imaging software. The digitization process translates a video image onto a 512 x 512 pixel matrix. Color is preserved in the digitized image with up

[2]The approach began by identifying the components of a 2 by 2 design varying both motion and sound, and thereby producing four different conditions. However, the static representation of a river with the sound of rushing water was eliminated as not being interpretable (Anderson et al., 1983).

to 32,768 color levels, although some clarity is lost in the translation from a video image to a digitized image (Orland, 1986; Vining & Orland, 1989).

The differences between presentational media were corrected for by varying motion only in the video sequences and abandoning the color slides. However, one could argue that the color slides and digitized images may not similarly represent the river flow levels, and any differences in the static condition between Experiment 1 and Experiment 2 may be due to the different media, not the incremental effect of motion. A pilot experiment was designed to compare ratings of flow level between the two static media conditions, color slide and digitized image, on a subset of the original stimuli.

Pilot. In order to determine if color slides and digitized images represented flow levels similarly, ten scenes were selected at random from the original set of stimuli for both conditions. Although the color slide flow rates did not always exactly correspond to the video flow rates, an effort was made to keep flow levels similar across five different flow levels (Table 7). The complete design matrix of the pilot study consisted of ten scenes across five flow levels yielding 50 scenes.

Subjects in each of the two conditions viewed and rated the fifty scenes in a predetermined random order. Subjects were nested within condition, such that no one subject rated scenes in both conditions. Subjects were instructed to rate the flow level of the river for each scene on a ten-point scale, where a rating

of 1 indicated a low flow level and a 10 indicated a high flow level. The instructions stressed that the rating was for the amount of water in the stream bed and not the quality of the scene. Subjects previewed ten scenes randomly selected from the remainder of the stimuli, which depicted a full range of the five flow levels. The preview scenes for the pilot rating session were shown for 5 seconds each, and the stimuli scenes for the pilot rating session were shown for 8 seconds each.

In all twenty-six subjects, ten in the digitized image condition and sixteen in the color slide condition, were used in the pilot study. All subjects were enrolled in the introductory psychology classes at the University of Arizona, and each student received credit toward a research requirement for participation in this study.

Subjects' ratings for each of the conditions were adjusted for presentation order, and then scaled using the program RMRATE (Brown et al., 1990). The group-to-group correlation, an indicator of the mean correlation between the experimental sample and any other sample drawn from the same population, for the color slide condition was $r=0.95$ and for the digitized image condition was $r=0.84$. The coefficients indicated substantial agreement among observer groups for ratings of flow level.

Ratings of flow were averaged across scene, and are presented graphically in Figure 2. Both of the slope functions for digitized images and color slides have linear upward trends with a slight drop in the digitized image condition at the last

flow level. The correlation between the ratings of these two conditions was r=0.95, indicating substantial agreement between ratings of flow in either condition. Digitized images appear to represent river flow levels as well as color slides.

Design

To investigate the incremental effects of preserving the existing motion and sound of a dynamic landscape, scenic beauty judgments needed to be obtained for the three conditions previously identified. Having established that digitized images preserve as much information regarding flow level as color slides and that digitized images can eliminate the unwanted variation between presentational media, digitized images were selected to be used in the static no sound (DI) condition.

Video Conditions. The same video sequences previously described in Experiment 1 were employed in both the dynamic with sound and dynamic without sound conditions. Since large differences did not emerge across the different random orders in Experiment 1, only the first random order in each set of scenes was used. Presentation of the single random order required a total of three observer groups. The river scenes in both the video conditions were displayed on the same monitor used in Experiment 1, using a commercial high quality four-head videotape player.

Digitized Image Condition. The same scenes previously described were captured as static digitized images and presented in the same scene sets as Experiment 1. As in the video

conditions, only one random order of each set of scenes was used. The scenes in the digitized image condition were displayed on the same monitor as in the video conditions, using a image presentation software package (TRUEVISION).

Procedure. In order to maintain as much commonality as possible between the experiments, the procedures did not substantially differ. After being read the instructions by the experimenter, subjects previewed the same twenty preview scenes used in Experiment 1. Preview scenes were shown for approximately 5 seconds each, and the stimuli scenes for both the video conditions and the digitized image condition were shown for 12 seconds each. For all three conditions, subjects' ratings were adjusted for presentation order, and then scaled using the program RMRATE (Brown et al., 1990) to produce Scenic Beauty Estimates (SBEs) for each scene.

Subjects. Observers were nested within each condition, such that no one subject rated more than one scene set or condition. Observers were enrolled in introductory psychology classes at the University of Arizona, and each student received experimental credit toward a class requirement for participation. A total of 103 observers were run in the video with sound condition, 78 in the video without sound condition, and 158 in the digitized image condition. See Table 8 for entire listing. In all, 339 subjects rated the river scenes.

Results

Reliabilities. Group-to-group reliabilities for the video

with sound condition were r=0.86, r=0.88, and r=0.95, for scene sets one to three respectively (Table 9). The group-to-group reliabilities for the video without sound condition were r=0.88, r=0.79, and r=0.87, for scene sets one to three respectively (Table 9). The group-to-group reliabilities for the digitized image condition were r=0.91, r=0.92, and r=0.95, for scene sets one to three respectively (Table 9). The group-to-group correlation is an indicator of the mean correlation between the experimental sample and any other sample of the same size drawn from the same population (Ebel, 1951). The coefficients were consistent across both scene sets and conditions, indicating substantial agreement with any other group drawn from the same population. In addition, the group-to-group correlations reported in the present study are very similar to those reported by Brown and Daniel (1991).

Another indicator of the degree to which the different observer groups agreed about the relative scenic beauty of the scenes is the correlation between the common baseline scenes within each condition. This reliability coefficient represents the agreement of SBE ratings for the twenty baseline scenes across the different sets of scenes within each condition. These correlations ranged between 0.58 to 0.81, with a median of 0.68, and were similar to those reported by Brown and Daniel (1991).

Scenic Beauty Estimates. The relationship between flow level and scenic beauty was assessed by regressing the SBE values on the flow level measures across all scenes within each

condition. Since the best predictor of scenic value in the video condition of Experiment 1 was the squared term of flow, flow level was entered into the regression equation as both a simple and squared term. The resulting regression equations for the video with sound (VS), video no sound (VNS), and digitized image (DI) conditions are presented in Table 11.

The data in all three conditions indicate a significant relationship between SBE values and flow level for both the simple and polynomial terms. However, the adjusted-R^2 values for each condition vary significantly between conditions, with the VS condition highest (.28), the VNS condition moderate (.18), and the DI condition lowest (.05). Since the adjusted-R^2 in Experiment 2 is an indicator of the amount of variance in SBEs explained by the variance of the simple and polynomial terms of flow level, the differences in the sufficiency of the presentational media to represent the relationship between flow and scenic beauty are evident.

The SBEs for each stimulus were averaged across all scenes within each flow level within each condition. The results of this procedure are displayed graphically in Figure 3, and provides a convenient index of the effect of flow on scenic beauty. Based on the earlier study of Brown and Daniel (1991), the flow function of the video conditions was expected to be polynomial, with the SBEs peaking between 1100 and 2300cfs. In comparing the two figures, the function of the VS condition in the present experiment is very similar to the polynomial function

of the video condition reported in Experiment 1.

The VNS and DI conditions, however, appear to be more linear than polynomial functions. For both of these two conditions, the relative contribution of the simple flow term is greater than that of the polynomial flow term (Table 11). This is a rather interesting result, in that it seems that for the video conditions, which preserved the motion of the river, should be more similar in form with each other rather than with the static condition. Although the digitized image function is less variable than either video condition, it shows much more variability than the slide condition in Experiment 1.

In addition, it should be noted that the VS condition in Experiment 2 was a direct replication of the video condition in Experiment 1, and produced markedly similar results ($r=0.98$) to the prior experiment. Hence, the polynomial function between flow and perceived scenic beauty should be considered robust, and not due to some unknown intervening variable. The VNS condition produced a similar, although attenuated function when compared to the VS polynomial function. The DI condition, which lacked information regarding both motion and sound, produced the least responsive function in explaining flow levels.

In explaining the incremental progression from the static and no sound condition (DI) to the dynamic and sound condition (VS), it was believed that the presence of sound possibly drew attention to the motion in the VS representation by making motion more salient to the observer. Hence, the ratings of the dynamic

without sound (VNS) condition lied between the two extremes. The addition of motion enabled some differences in perceived scenic beauty between in-stream flow levels to be noticed, but the relationship was severely diminished. Without information pertaining to both motion and sound in a dynamic landscape, the underlying relationship between perceived scenic beauty and in-stream flow levels would not have been discovered.

Conclusions

The intent of this research was to investigate the incremental validity of representational surrogates of dynamic environments, and began with the fact that photographs have been shown to be valid surrogates for relatively static environments. In Experiment 1 we investigated whether or not a systematic difference existed between static and dynamic representations for a dynamic environment, and we concluded that the static surrogate (viz., color slides) did not sufficiently preserve particular environmental features, while the dynamic surrogate (viz., video) was able to identify systematic differences in ratings of scenic beauty. The pilot study demonstrated that when observers are instructed to attend to flow level, reliable ratings of the physical variable can be obtained. In Experiment 2, we controlled for any possible alternative hypotheses in order to obtain a better estimate of the ability of a surrogate to reproduce important environmental information.

Although motion was believed by Brown and Daniel (1991) to be the modalitity of which provided researchers the opportunity

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to explore the relationship between perceived scenic beauty and flow level, the results reported herein indicate that both sound and motion influence judgments of scenic beauty. Motion without sound produces similar results to the static digitized image condition, while the motion with sound and the original video results suggested a consistent polynomial relationship between perceived scenic beauty and flow.

The results presented herein implicate the *de facto* acceptance of either static or dynamic surrogates to represent environmental stimuli without consideration of the type of information required of an observer to make consistent ratings. Before selection of an environmental surrogate to represent landscapes, researchers need to evaluate whether or not the addition of different environmental information would enhance the representation's ability to better predict responses to the actual environment.

The purpose of this series of experiments was to investigate the incremental addition of environmental information to the standard representation format in environment perception research: the static slide. If systematic differences indeed do exist between media of representation, then researchers should endeavor themselves to discover what other environmental attributes have been ignored because they are not captured by the presentation medium used as a surrogate for the landscape under investigation.

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Table 1. Sample Dates and Flow Levels

Date (1988)	CFS* Video	CFS* Slides
June 7	2643	
June 9		3092
June 14	2304	
June 21		2304
June 22	1975	
June 27		1763
June 28		1483
June 30	1202	
July 1		1105
July 5		992
July 7		820
July 8	715	
July 12		675
July 18		553
July 21	479	
July 25		479
August 23	373	
August 25		373
September 8	157	
September 9		152

*Cubic feet per second measured at the lower end of the inventoried stretch of river at USGS gauge #06752000.

Table 2. Number of Subjects and Scenes Judged for Experiment 1

	Slide Condition		Video Condition	
	Scenes	Subjects	Scenes	Subjects
Baseline	19		20	
Nonbaseline				
Set 1	111		67	
Order 1		12		11
Order 2		9		7
Order 3		11		7
Set 2	130		67	
Order 1		10		10
Order 2		18		9
Order 3		11		13
Set 3	130		66	
Order 1		22		10
Order 2		7		7
Order 3		11		9
Set 4	132			
Order 1		9		
Order 2		11		
Order 3		18		
Total	522	149	220	85

Table 3. Baseline Correlations of Random Orders for SBEs of Slide and Video Conditions

Random Order 1

	1A	1B	1C
1A	1.0		
1B	.55(.50)	1.0	
1C	.72(.82)	.79(.66)	1.0

Random Order 2

	2A	2B	2C
2A	1.0		
2B	.09(.61)	1.0	
2C	.71(.72)	.30(.59)	1.0

Random Order 3

	3A	3B	3C
3A	1.0		
3B	.65(.63)	1.0	
3C	.86(.66)	.71(.47)	1.0

Random Order 4

	4A	4B	4C
4A	1.0		
4B	.82	1.0	
4C	.70	.73	1.0

( ) = Video Condition correlations

Table 4. Baseline Correlations of Scene Sets for SBEs of Slide and Video Conditions

Slide Condition

	1	2	3	4
1	1.0			
2	.68	1.0		
3	.57	.82	1.0	
4	.62	.84	.79	1.0

Video Condition

	1	2	3
1	1.0		
2	.85	1.0	
3	.87	.86	1.0

Table 5. Group-to-group Reliabilities of Observer Ratings in Experiment 1

Scene Set	Video Condition	Slide Condition
1	.81	.69
2	.87	.83
3	.89	.83
4		.81

Table 6. Regression Estimates for Slide and Video Conditions

Variable	Video Condition	Slide Condition
Constant	-48.10 (-2.79)*	-6.91 (-0.84)
Flow	0.13 (3.74)	0.02 (1.18)
$Flow^2$	-5.86 E-5 (-4.57)	-5.01 E-6 (-0.86)
R^2	0.11	0.0001
F	14.72	1.04

*Numbers in parentheses are Student's t-ratios.

Table 7. Comparable Flow Levels Across Conditions

CFS*	
Video	Slides
157	152
373	373
1202	1105
1975	1763
2303	2304

Table 8. Number of Subjects and Scenes Judged for Experiment 2

	Video Sound Condition		Video No Sound Condition		Digitized Image Condition	
	Scenes	Subjects	Scenes	Subjects	Scenes	Subjects
Baseline	20		20		20	
Nonbaseline						
Set 1	67	33	67	30	67	60
Set 2	67	34	67	21	67	58
Set 3	66	36	66	27	67	40
Total	220	103	220	78	220	158

Table 9. Group-to-group Reliabilities of Observer Ratings in Experiment 2

Scene Set	Video Sound Condition	Video No Sound Condition	Digitized Image Condition
1	.86	.88	.91
2	.88	.79	.92
3	.95	.87	.95

Table 10. Baseline Correlations of Scene Sets for SBEs of Video Conditions and Digitized Image Condition

Video Sound Condition

	1	2	3
1	1.0		
2	.68	1.0	
3	.65	.80	1.0

Video No Sound Condition

	1	2	3
1	1.0		
2	.64	1.0	
3	.58	.81	1.0

Digitized Image Condition

	1	2	3
1	1.0		
2	.63	1.0	
3	.80	.77	1.0

Table 11. Regression Estimates for Video Sound, Video No Sound, and Digitized Image Conditions

Variable	Video Sound Condition	Video No Sound Condition	Digitized Image
Constant	-91.08 (-7.24)*	-45.89 (-6.61)	-28.56 (-4.10)
Flow	0.21 (8.11)	0.09 (6.38)	0.05 (3.41)
$Flow^2$	-7.76 E-5 (-8.49)	-3.10 E-5 (-6.20)	-1.62 E-5 (-3.24)
R^2	0.28	0.18	0.05
F	36.75	20.41	5.97

*Numbers in parentheses are Student's t-ratios.

Figure 1. Relationship Between Flow and Scenic Beauty, Experiment 1

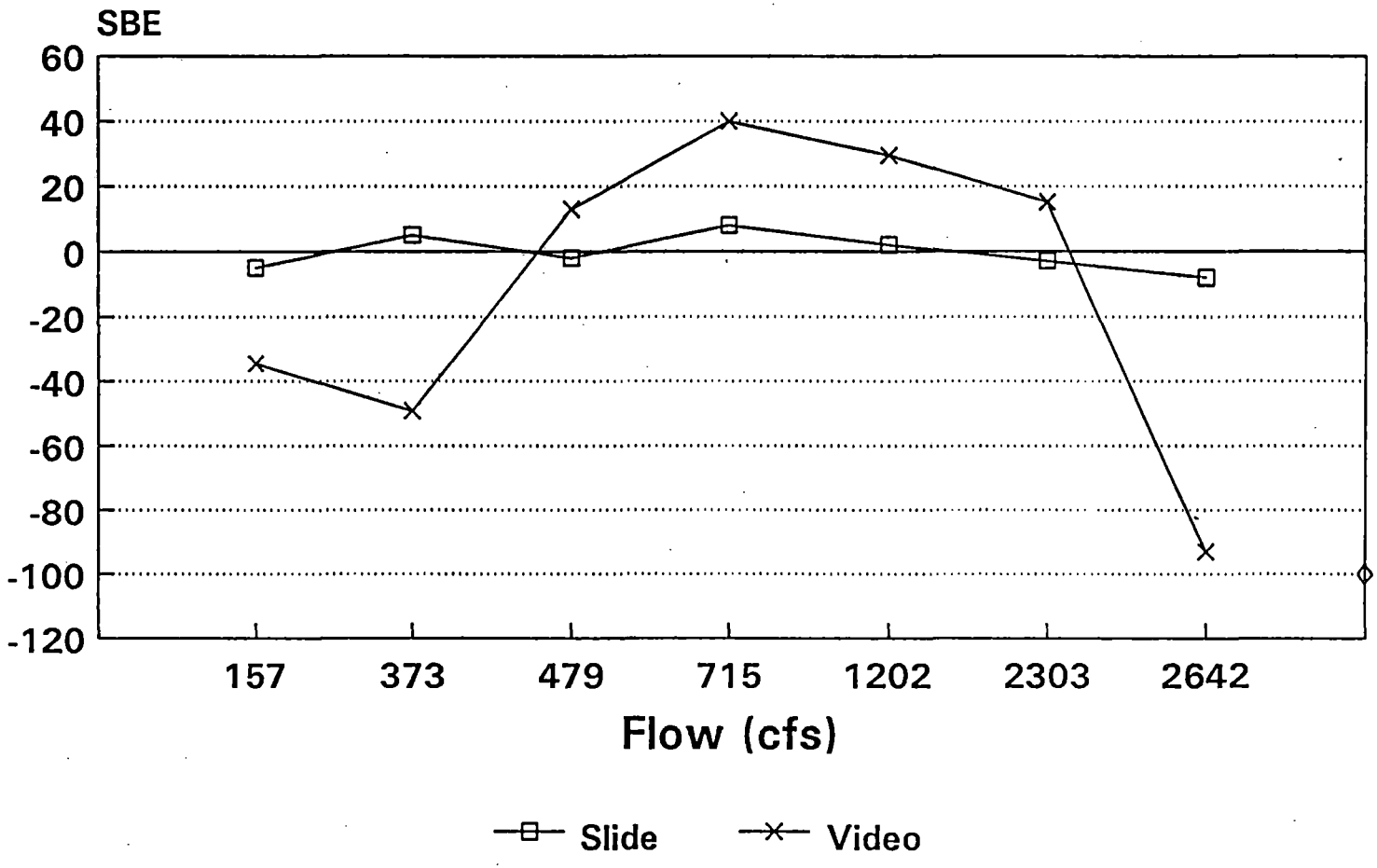

Figure 2. Mean Ratings of Flow Level by Condition, Pilot Study

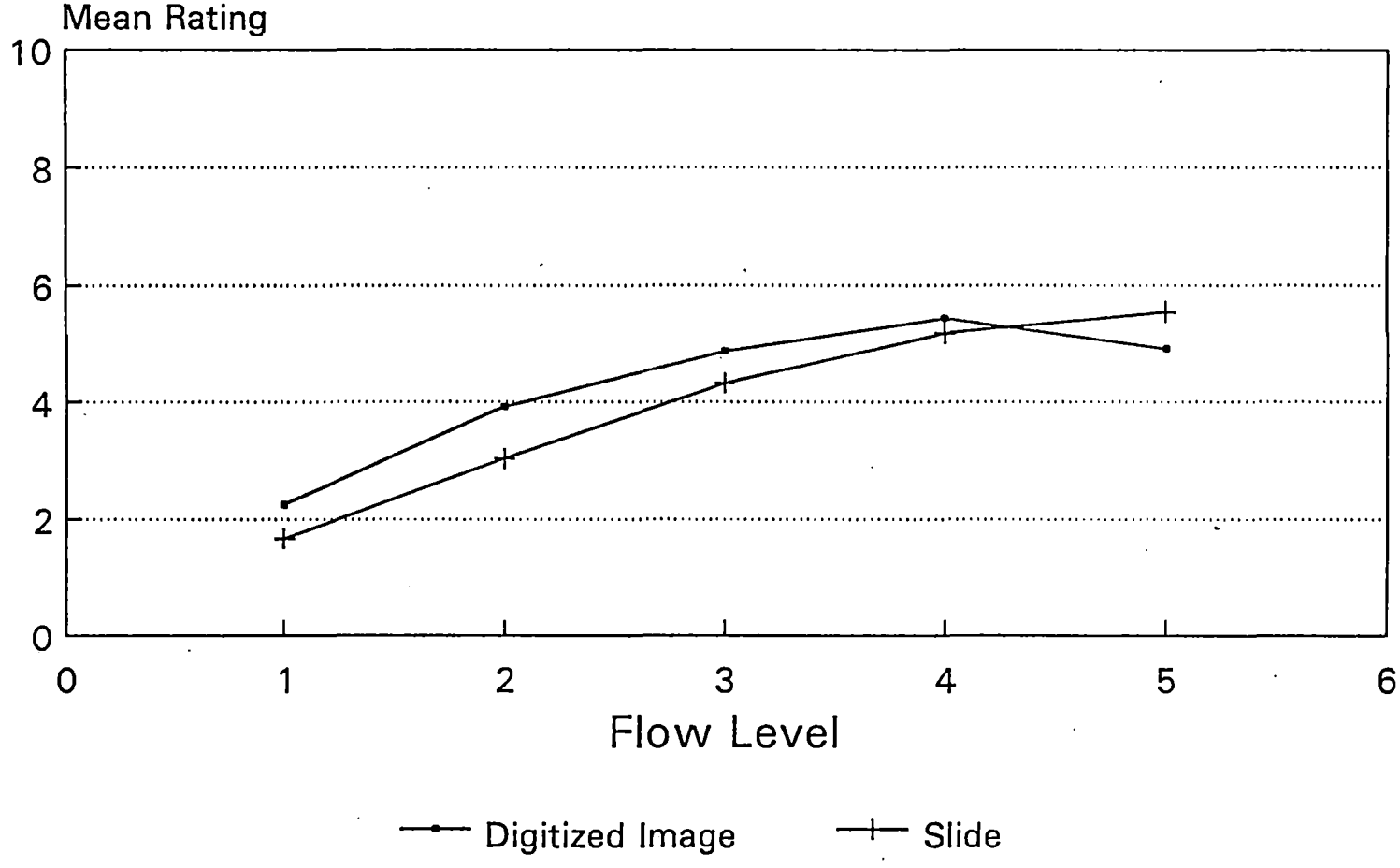

Figure 3. Relationship Between Flow and Scenic Beauty, Experiment 2